DRAFT

e-Front runners

STARTING GUIDE

FRENIC Eco · FRN-F1

Fuji Electric frequency inverter
for HVAC applications

3-phase 400V
0.75 – 500kW

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Preface

Thank you for purchasing our FRENIC-Eco series of inverters.
This product is designed to drive a three-phase induction motor for fan and pump applications.

Read through this starting guide and become familiar with proper handling and operation of this product. Please note that this starting guide should enable you to get familiar with the main functions and should help you to install the inverter. Not all functions are described here. For more detailed information please refer absolutely to the attached CD-ROM which contains the user manual (MEH456).

Improper handling might result in incorrect operation, a short life, or even a failure of this product as well as the motor.
Have this manual delivered to the end user of this product. Keep this starting guide and CD-ROM in a safe place until this product is discarded.

Listed below are the other materials related to the use of the FRENIC-Eco. Read them in conjunction with this starting guide as necessary.

- FRENIC-Eco User's Manual (MEH456)
- RS485 Communication User's Manual (MEH448)
- Catalogue (MEH442)
- RS485 Communications Card "OPC-F1-RS" Installation Manual (INR-SI47-0872)
- Relay Output Card "OPC-F1-RY" Instruction Manual (INR-SI47-0873)
- Mounting Adapter for External Cooling "PB-F1" Installation Manual (INR-SI47-0880)
- Panel-mount Adapter "MA-F1" Installation Manual (INR-SI47-0881)
- Multi-function Keypad "TP-G1" Instruction Manual (INR-SI47-0890-E)
- FRENIC Loader Instruction Manual (INR-SI47-0903-E)

The materials are subject to change without notice. Be sure to obtain the latest editions for use.

1. SAFETY INFORMATION AND CONFORMITY TO STANDARDS

1.1 Safety Information

Read this manual thoroughly before proceeding with installation, connections (wiring), operation, or maintenance and inspection. Ensure you have sound knowledge of the device and familiarize yourself with all safety information and precautions before proceeding to operate the inverter.

Safety precautions are classified into the following two categories in this manual.

Application

⚠WARNING

- FRENIC-Eco is designed to drive a three-phase induction motor. Do not use it for single-phase motors or for other purposes. **Fire or an accident could occur.**
- FRENIC-Eco may not be used for a life-support system or other purposes directly related to the human safety.
- Though FRENIC-Eco is manufactured under strict quality control, install safety devices for applications where serious accidents or material losses are foreseen in relation to the failure of it. **An accident could occur.**

Installation

⚠WARNING

- Install the inverter on a nonflammable material such as metal. **Otherwise fire could occur.**
- Do not place flammable matter nearby. **Doing so could cause fire.**

⚠CAUTION

- Do not support the inverter by its terminal block cover during transportation. **Doing so could cause a drop of the inverter and injuries.**
- Prevent lint, paper fibers, sawdust, dust, metallic chips, or other foreign materials from getting into the inverter or from accumulating on the heat sink. **Otherwise, a fire or an accident might result.**
- Do not install or operate an inverter that is damaged or lacking parts. **Doing so could cause fire, an accident or injuries.**
- Do not get on a shipping box.
- Do not stack shipping boxes higher than the indicated information printed on those boxes. **Doing so could cause injuries.**

Maintenance and inspection, and parts replacement

⚠WARNING

- Turn the power OFF and wait for at least five minutes for models of 30 kW or below, or ten minutes for models of 37 kW or above, before starting inspection. Further, check that the LED monitor is unlit, and check the DC link bus voltage between the P (+) and N (-) terminals to be lower than 25 VDC. **Otherwise, electric shock could occur.**
- Maintenance, inspection, and parts replacement should be made only by qualified persons.
- Take off the watch, rings and other metallic matter before starting work.
- Use insulated tools. **Otherwise, electric shock or injuries could occur.**

Disposal

⚠CAUTION

- Handle the inverter as an industrial waste when disposing of it. **Otherwise injuries could occur.**

Others

⚠WARNING

- Never attempt to modify the inverter. **Doing so could cause electric shock or injuries.**

Wiring

⚠WARNING

- When wiring the inverter to the power source, insert a recommended molded case circuit breaker (MCCB) or residual-current-operated protective device (RCD)/earth leakage circuit breaker (ELCB) (with overcurrent protection) in the path of power lines. Use the devices within the recommended current range.

- Use wires in the specified size. **Otherwise, fire could occur.**
- Do not use one multicore cable in order to connect several inverters with motors.
- Do not connect a surge killer to the inverter's output (secondary) circuit. **Doing so could cause fire.**
- Ground the inverter following Class C or Class D specifications or national/local electric code, depending on the input (primary) voltage of the inverter. **Otherwise, electric shock could occur.**
- Qualified electricians should carry out wiring.
- Be sure to perform wiring after turning the power OFF. **Otherwise, electric shock could occur.**
- Be sure to perform wiring after installing the inverter body. **Otherwise, electric shock or injuries could occur.**
- Ensure that the number of input phases and the rated voltage of the product match the number of phases and the voltage of the AC power supply to which the product is to be connected. **Otherwise fire or an accident could occur.**
- Do not connect the power source wires to output terminals (U, V, and W). **Doing so could cause fire or an accident.**
- Generally, control signal wires are not enforced- insulated. If they accidentally touch any of hot power lines, their insulation coat may break for any reasons. In such a case, an extremely high voltage may be applied to the signal lines. Make a complete remedy to protect the signal line from contacting any hot high voltage lines. **Otherwise, an accident or electric shock could occur.**

⚠CAUTION

- Wire the three-phase motor to terminals U, V, and W of the inverter, aligning phases each other. **Otherwise injuries could occur.**
- The inverter, motor and wiring generate electric noise. Take care of malfunction of the nearby sensors and devices. To prevent the motor from malfunctioning, implement noise control measures. **Otherwise an accident could occur.**

Setting control switches

⚠WARNING

- Before setting up any internal control switches, turn OFF the power, wait more than five minutes for models of 30 kW or below, or ten minutes for models of 37 kW or above, and make sure, using a multimeter or a similar instrument, that the DC link bus voltage between the terminals P (+) and N (-) has dropped below a safe voltage (+25 VDC)**. Otherwise electric shock could occur.**

Operation

⚠WARNING

- Be sure to install the terminal block cover and the front cover before turning the power ON. Do not remove the covers while power is applied. **Otherwise electric shock could occur.**
- Do not operate switches with wet hands. **Doing so could cause electric shock.**
- If the retry function has been selected, the inverter may automatically restart and drive the motor depending on the cause of tripping. (Design the machinery or equipment so that human safety is ensured after restarting.)
- If the stall prevention function (current limiter), automatic deceleration, and overload prevention control have been selected, the inverter may operate at an acceleration/deceleration time or frequency different from the commanded ones. Design the machine so that safety is ensured even in such cases. **Otherwise an accident could occur.**
- The STOP key is only effective when function setting (Function code F02) has been established to enable the STOP key. Prepare an emergency stop switch separately. If you disable the STOP key priority function and enable operation by external commands, you cannot emergency-stop the inverter using the STOP key on the built-in keypad.
- If an alarm reset is made with the Run command signal turned ON, a sudden start will occur. Ensure that the Run command signal is turned OFF in advance. **Otherwise an accident could occur.**
- If you enable the "restart mode after instantaneous power failure" (Function code F14 = 3, 4, or 5), then the inverter automatically restarts running the motor when the power is recovered. (Design the machinery or equipment so that human safety is ensured after restarting.)
- If you set the function codes wrongly or without completely understanding this instruction manual and the FRENIC-Eco User's Manual (MEH456), the motor may rotate with a torque or at a speed not permitted for the machine. **An accident or injuries could occur.**
- Do not touch the inverter terminals while the power is applied to the inverter even if the inverter stops. **Doing so could cause electric shock.**

⚠CAUTION

- Do not turn the main circuit power (circuit breaker) ON or OFF in order to start or stop inverter operation. **Doing so could cause failure.**
- Do not touch the heat sink because they become very hot. **Doing so could cause burns.**
- Setting the inverter to high speeds is easy. Before changing the frequency (speed) setting, check the specifications of the motor and machinery.
- The brake function of the inverter does not provide mechanical holding means. **Injuries could occur.**

GENERAL PRECAUTIONS

Drawings in this manual may be illustrated without covers or safety shields for explanation of detail parts. Restore the covers and shields in the original state and observe the description in the manual before starting operation.

1.2 Conformity to Standards

1.2.1 .Conformity to European Standards

The CE Approved on Fuji products indicates that they comply with the essential requirements of the Electromagnetic Compatibility (EMC) Directive 89/336/EEC issued by the Council of the European Communities and the Low Voltage Directive 73/23/EEC.

Only the models with a built-in EMC-compliant filter that bear a CE Approved are compliant with the EMC Directive.

Inverters that bear a CE Approved are compliant with the Low Voltage Directive.

¦ The FRENIC-Eco series of inverters with conformity to the following standards:

Low Voltage Directive	EN50178:1997	
EMC Directives	EN61800-3:1996 + A11: 2000	EN55011: 1998 + A1:1999

CAUTION

The FRENIC-Eco series of inverters are categorized as a "restricted sales distribution class" provided in the EN61800-3. When you use these products with any home appliance or office equipment, you may need to take appropriate countermeasures to reduce or eliminate any noise emitted from these products.

1.2.2 Conformity to Low Voltage Directive

General-purpose inverters are subject to the regulations set forth by the Low Voltage Directive in Europe. Fuji has obtained a certification of compliance from a European test organization for its FRENIC-Eco series inverters and labels them with a CE Approved, which is a self-declaration with conformity to the Low Voltage Directive.

Considerations when using FRENIC-Eco as a product with conformity to Low Voltage Directive

If you wish to use a FRENIC-Eco series inverter as a product with conformity to the Low Voltage Directive, refer to the related guidelines.

2. Mechanical Installation

2.1 Installing the Inverter

Mounting base

The inverter should be mounted on a base made of material that can withstand heat sink temperature, which can rise up to 90ºC approx. during inverter operation.

Clearances

Ensure that the minimum clearances indicated are maintained at all times. When installing the inverter in the enclosure of your system, take extra care with ventilation inside the enclosure as the temperature around the inverter will tend to increase. Do not install the inverter in a small enclosure with poor ventilation.

*For 37Kw or above a 50 mm clearance is needed instead of 10 mm (left and right sides).

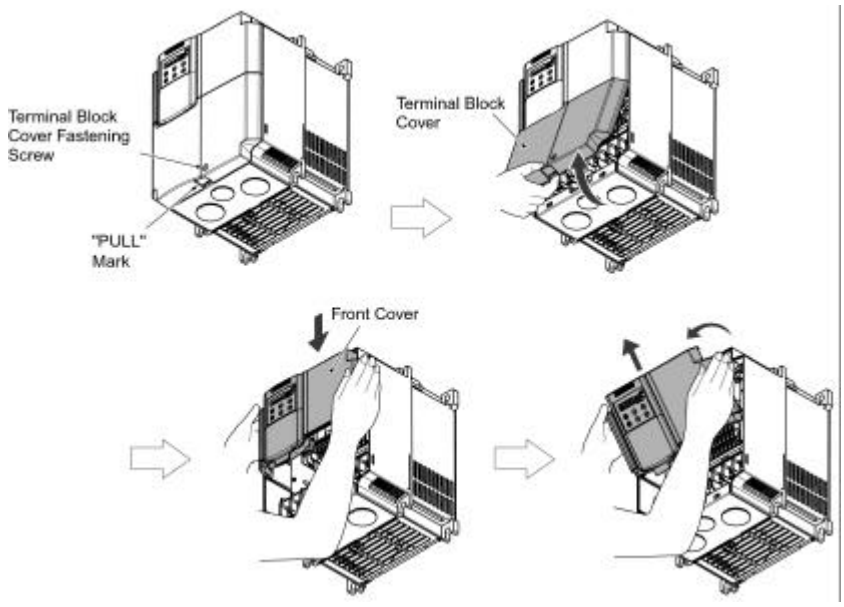
As long as the ambient temperature is 40°C or lower, 5.5 kW or lower inverters may be mounted side-by-side without any gap between them.
For others inverters, please follow the clearances needed.

2.2 Mounting Direction

Horizontal layout is recommended when two or more inverters are to be installed in an equipment or enclosure. If it is necessary to mount the inverters vertically, install a partition plate or the like between the inverters so that any heat radiating from an inverter will not affect the one/s above.

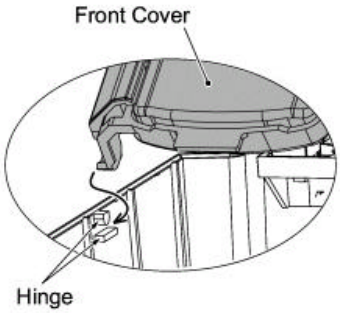
2.3 Removing and Mounting the Terminal Block (TB) Cover and the Front Cover

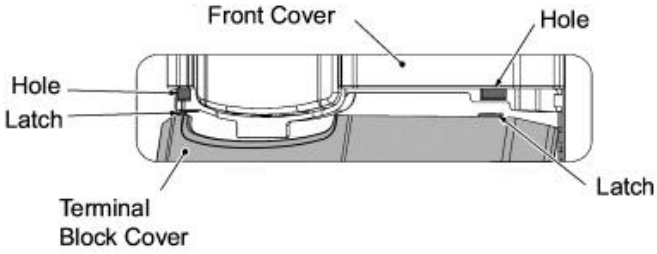
① To remove the TB cover, loosen the fastening screw on it, hold the dimple (labelled “PULL”), and pull it up towards you.
② To remove the front cover, hold it with both hands, slide it downward, disengage the latch at the top from the inverter, tilt the front cover toward you, and pull it upward.



For inverters with a capacity of 30 kW or below (for others please refer to user's manual chapter 2).

For mounting the covers, please refer to next snapshots and follow removing instructions in the opposite way.





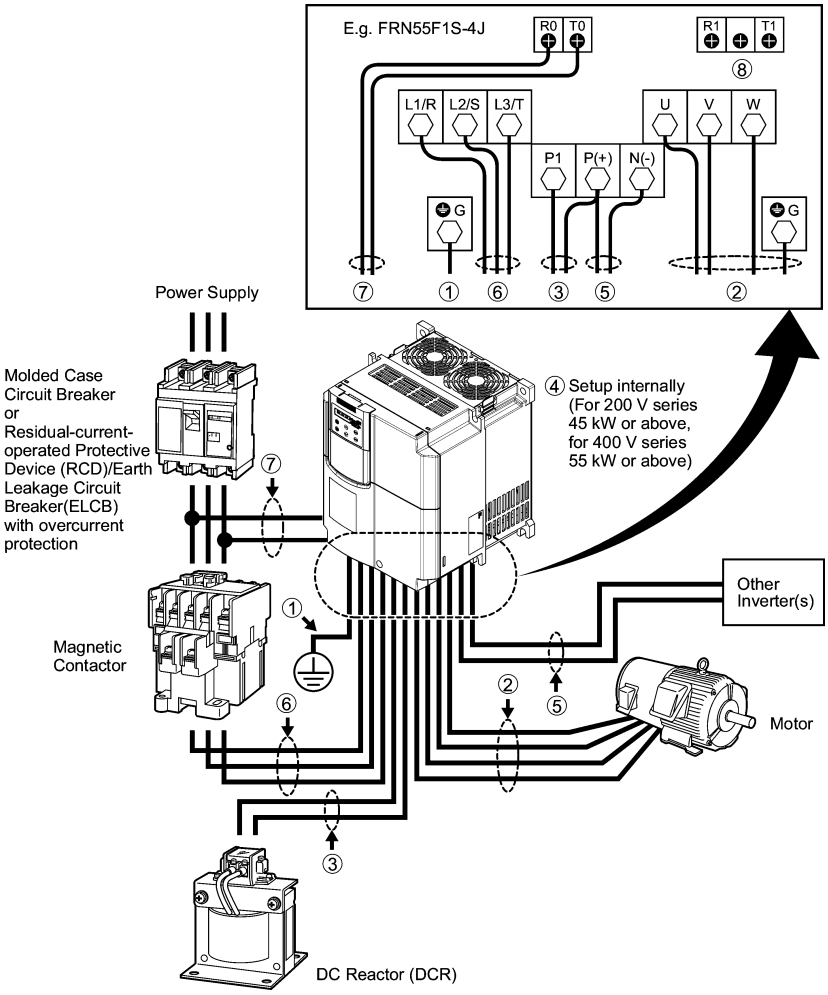
3. Electrical Installation

3.1. Power Terminals

* Perform wiring as necessary

Symbol	Wiring procedure	Terminal function	Description
L1/R, L2/S, L3/T	⑥	Main power inputs	Connect the 3-phase input power lines.
U, V, W	②	Inverter outputs	Connect a 3-phase motor
R0, T0	⑦ *	Auxiliary power input for the control circuit	For a backup of the control circuit power supply, connect AC power lines same as that of the main power input.
P1, P(+)	③ *	DC reactor connection	Connect a DC reactor (DCR) for improving power factor (an option for the inverter whose capacity is 55 kW or below).
P(+), N(-)	⑤ *	DC link bus	Connect a DC link bus of other inverter(s). An optional regenerative converter is also connectable to these terminals.
R1, T1	⑧ *	Auxiliary power input for the fans (Refer to chapter 8.4.1 of user's manual)	Normally, no need to use these terminals. Use these terminals for an auxiliary power input of the fans in a power system using a power regenerative PWM converter (RHC series).
⏚G x 2	①	Grounding for inverter and motor	Grounding terminals for the inverter's chassis (or case) and motor. Earth one of the terminals and connect the grounding terminal of the motor. Inverters provide a pair of grounding terminals that function equivalently.

④ Switching connectors (for models 400 V series 55 kW or above. Refer to chapter 8.4.1 of user's manual.)



3.2. Control Terminals

The FRENIC ECO inverter has 7 digital inputs (two fixed and five programmable), 3 programmable transistor outputs and 2 relay outputs (one fixed and one programmable).

Symbols	Type	Programmable	Example of use	Description
PLC	Connects to PLC output signal power supply	--	--	To turn ON or OFF digital inputs using a relay or a PLC. 24VDC max. current 50mA
CM	Digital common	--	--	Two common terminals for digital input signal terminals
FWD	Run forward command	YES	--	External run command UP
REV	Run reverse command	YES	--	External run command DOWN
X1-X5	Digital inputs	YES	Speed selection Coast to stop etc.	Programmable digital inputs Program the required function in parameters E01 through E05
Y5 A/C	General purpose relay output	YES	MC control signal Inverter ready	Programmable relay contact output. Program the required function in parameters E24 / E27
30 A,B,C	Alarm relay output	YES	Signal to control system that the inverter has an alarm	
Y1-Y3	Transistor outputs	YES	Same as relay output Y5 / 30A	Programmable transistor outputs. Program the required function in parameters E20 through E22
CMY	Transistor output common	--	--	Common terminal for transistor output signal terminals

Electrical specification for digital inputs (X1 to X5):

Item		Min.	Max.
Operation voltage (**SINK**)	ON level	0 V	2V
	OFF level	22 V	27V
Operation voltage (**SOURCE**)	ON level	22 V	27V
	OFF level	0 V	2V
Operation current at ON (Input voltage is at 0V)		2.5 mA	5 mA
Allowable leakage current at OFF		-	0.5 mA

Electrical specification for transistor outputs:

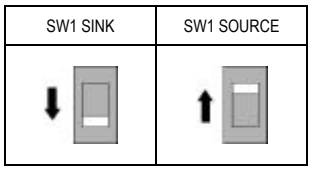
Item		Max.
Operation voltage	ON level	3 V
	OFF level	27 V
Maximum load current at ON		50 mA
Leakage current at OFF		0.1 mA

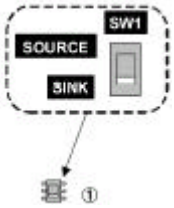
Electrical specification for relay contact outputs: 48 VDC, 0.5 A

3.2.1 Control Terminals Connection

Digital inputs and outputs can be operated both in NPN (sink) and PNP (source) logic.

a) DIGITAL INPUTS: Refer to the user's manual MEH456 for connection examples.





The switch SW1 located on the control board defines the logic used for digital inputs. Factory default setting is source.

? SINK LOGIC: Digital input ON giving 0 volts.
? SOURCE LOGIC: Digital input ON giving 24 volts.

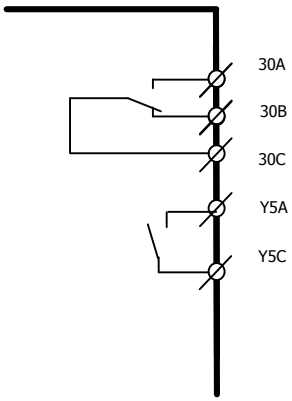
b) TRANSISTOR OUTPUTS: Refer to the user's manual MEH456 for connection examples.

To decide what logic to use, there is no switch as before.
Connecting “PLC” terminal to the transistor common “CMY” terminal you will have PNP logic.
Connecting “CM” terminal to the transistor common “CMY” terminal you will have NPN logic.

c) RELAY OUTPUTS:

Y5A/C RELAY: you can switch its output mode between “Active ON” (the terminals [Y5A] and [Y5C] are short-circuited if the signal is active) and “Active OFF” (the terminals [Y5A] and [Y5C] are open-circuited if the signal is active).

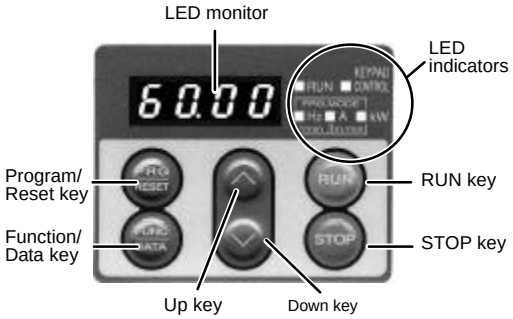
30A/B/C RELAY: switching of the normal/negative logic output is applicable to the following two contact outputs: "Terminals [30A] and [30C] are short-circuited for ON signal output (Active ON)" or "the terminals [30B] and [30C] are short-circuited (non-excite) for ON signal output (Active OFF)."



4. OPERATION USING THE KEYPAD

As shown in the figure at right, the keypad consists of a four-digit LED monitor, 5 LED indicators, and six keys.

The keypad allows you to start and stop the motor, monitor running status, and switch to the menu mode. In the menu mode, you may set the function code data, monitor I/O signal states, maintenance information, and alarm information.



Item	Monitor, LED indicators and Keys	Functions
LED Monitor	60.00	Four-digit, 7-segment LED monitor which displays the following according to the operation modes. ■ In Running Mode: Running status information (e.g., output frequency, current, and voltage) ■ In Programming Mode: Menus, function codes and their data ■ In Alarm Mode: Alarm code, which identifies the error factor if the protective function is activated.
Operation Keys	PRG RESET	Program/Reset key which switches the operation modes of the inverter. ■ In Running Mode: Pressing this key switches the inverter to Programming Mode. ■ In Programming Mode: Pressing this key switches the inverter to Running Mode. ■ In Alarm Mode: Pressing this key after removing the error factor will switch the inverter to Running Mode.
	FUNC DATA	Function/Data key which switches the operation you want to do in each mode as follows: ■ In Running Mode: Pressing this key switch the information to be displayed concerning the status of the inverter (output frequency (Hz), output current (A), output voltage (V), etc.). ■ In Programming Mode: Pressing this key displays the function code and sets the data entered with ▲ and ▼ keys. ■ In Alarm Mode: Pressing this key displays the details of the problem indicated by the alarm code that has come up on the LED monitor.
	RUN	RUN key. Press this key to run the motor.
	STOP	STOP key. Press this key to stop the motor.
	▲ and ▼	UP and DOWN keys. Press these keys to select the setting items and change the function data displayed on the LED monitor.
LED Indicators	RUN LED	Lights when any run command to the inverter is active, In Programming and Alarm modes, you cannot run the inverter even if the indicator lights.
	KEYPAD CONTROL LED	Lights when the inverter is running by the run command from the RUN key.
	Unit and Mode expression by the three LED indicators	The lower 3 LED indicators identify the unit of numeral displayed on the LED monitor in Running Mode by combination of lit and unlit states of them in the category shown below. kW, A, Hz, r/min and m/min While the inverter is in Programming Mode, the LEDs at both ends of the lower indicators light. In Programming Mode: ¦ Hz ? A ¦ kW

5. QUICK STARTING COMMISSIONING

5.1 Running the Motor for a Test

5.1.1 Inspection and preparation prior to powering on

Check the following prior to starting powering on.

(1) Check if connection is correct.

Especially check if the power wires are connected to the inverter input terminals L1/R, L2/S and L3/T, and output terminals U, V and W respectively and that the grounding wires are connected to the ground electrodes correctly. Note that FRENIC-Eco series inverter is designed for three phase input and driving three phase motors.

⚠WARNING

- Do not connect power supply wires to the inverter output terminals U, V, and W. Otherwise, the inverter may be broken if you turn the power on.
- Be sure to connect the grounding wires of the inverter and the motor to the ground electrodes.

Otherwise, electric shock may occur.

(2) Check for short circuits between terminals and exposed live parts and ground faults.

(3) Check for loose terminals, connectors and screws.

(4) Check if the motor is separated from mechanical equipment.

(5) Turn the switches off so that the inverter does not start or operate erroneously at power-on.

(6) Check if safety measures are taken against runaway of the system, e.g., a defense to protect people from unexpectedly approaching your power system.

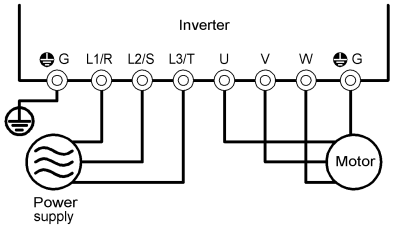


Figure 5.1 Connection of Main Circuit Terminals

5.1.2 Turning on power and checking

Turn the power on and check the following points. This is a case when no function code data is changed from the factory setting.

(1) Check if the LED monitor displays "**00* " (means that the frequency command is 0 Hz) that is blinking. (See Figure 5.2.)

If the LED monitor displays numbers except "**00* " then press the ▲ / ▼ key to set "**00* " as the frequency command.

(2) Check if a built-in cooling fan rotates.

Figure 5.2 Display of the LED Monitor after Power-on

5.1.3 Preparation before running the motor for a test--Setting function code data

Before starting running the motor, set function code data specified in Table 5.1 to the motor ratings and your system design values. For the motor, check the rated values printed on the nameplate of the motor. For your system design values, ask system designers about them.

📖 For details about how to change function code data, refer to Chapter 4. Refer to the function code H03 in Chapter 6 "FUNCTION CODES" for the factory default setting of motor parameters. If any of them is different from the default setting, change the function code data.

Table 5.1 Settings of Function Code Data before Driving the Motor for a Test

Function code	Name	Function code data	Factory setting
F 04	Base frequency	Motor ratings (printed on the nameplate of the motor)	50.0 (Hz)
F 05	Rated voltage (at base frequency)		0 (V) (Output voltage interlocked with the input voltage)
F 03	Maximum frequency	System design values * For a test-driving of the motor, increase values so that they are longer than your system design values. If the set time is short, the inverter may not start running the motor.	50.0 (Hz)
F 07	Acceleration time 1*		20.0 (sec)
F 08	Deceleration time 1*		20.0 (sec)
P 02	Motor parameter (Rated capacity)	Motor ratings (printed on the nameplate of the motor)	Applicable motor rated capacity
P 03	Motor parameter (Rated current)		Rated current of applicable motor
P 99	Motor Selection		0: Characteristic of ICE motor.

5.1.4 Procedure for Test Run

(1) Turn the power on and check that the LED monitor blinks while indicating the **00* Hz frequency.

(2) Set the frequency to a low frequency such as 5 Hz, using the ⌃ / ⌄ key. (Check that frequency command blinks on the LED monitor.)

(3) Press the RUN key to start running the motor in the forward direction. (Check that the frequency command is displayed on the LED monitor correctly.)

(4) To stop the motor, press the STOP key.

<Check the following points>

- Check if the direction of rotation is forward.
- Check for smooth rotation without motor humming or excessive vibration.
- Check for smooth acceleration and deceleration.

When no abnormality is found, press the RUN key again to start driving the motor, and increase the frequency command using the ⌃ / ⌄ key. Check the above points for the test-driving of the motor.

5.2 Operation

After confirming normal operation by performing a test run, make mechanical connections (connections of the machine system) and electrical connections (wiring and cabling), and set the necessary parameters properly before starting a production run.

Note Depending on the conditions of the production run, further adjustments can be required, such as adjustments of torque boost (F09), acceleration time (F07), and deceleration time (F08). Make sure to set relevant function codes properly.

6. FUNCTION CODES

6.1 Function Codes Tables

Function codes enable the FRENIC-Eco series of inverters to be set up to match your system requirements.

Each function code consists of a 3-letter string. The first letter is an alphabet that identifies its group and the following two letters are numerals that identify each individual code in the group. The function codes are classified into eight groups: Fundamental Functions (F codes), Extension Terminal Functions (E codes), Control Functions of Frequency (C codes), Motor Parameters (P codes), High Performance Functions (H codes), Application Functions (J codes), Link Function (y codes) and. Option Function (o codes) To determine the property of each function code, set data to the function code.

For Option function (o codes), refer to the instruction manual for the option.

■ Using negative logic for programmable I/O terminals

The negative logic signaling system can be used for the digital input and output terminals by setting the function codes specifying the properties for those terminals. Negative logic refers to inverted ON/OFF (logical value 1 (true)/0 (false)) state of input or output signal. An ON-active signal (the function takes effect if the terminal is short-circuited.) in the normal logic system is functionally equivalent to OFF-active signal (the function takes effect if the terminal is opened.) in the negative logic system.

To set the negative logic system for an I/O signal terminal, display data of 1000s (by adding 1000 to the data for the normal logic) in the corresponding function code and then press the key.

For example, if a coast-to-stop command (BX: data = 7) is assigned to any one of digital input terminals [X1] to [X3] by setting any of function codes E01 through E03, then turning (BX) on will make the motor coast to a stop. Similarly, if the coast-to-stop command (BX: data = 1007) is assigned, turning (BX) off will make the motor coast to a stop.

The following tables list the function codes available for the FRENIC-Eco series of inverters.

If you find any [-] (not available here) mark in the related page column of the function code tables, refer to FRENIC-Eco User's Manual (MEH456) for details.

F codes: Fundamental functions

Code	Name		Setting Range	Factory default	See Page:
F00	Data Protection		0 / 1	0	
F01	Frequency command 1		0 ~ 3 / 5 / 7	0	14
F02	Operation method		0 ~ 4	0	15
F03	Maximum frequency1		25 ~ 120Hz	50Hz	16
F04	Base frequency 1		25 ~ 120Hz	50Hz	16
F05	Rated voltage 1		0 / 160 ~ 500V	400V	16
F07	Acceleration time 1		0.00 ~ 3600s	20s	16
F08	Deceleration time 1		0.00 ~ 3600s	20s	16
F09	Torque boost 1		0.0 ~ 20.0	Depending on the rated capacity	17
F10	Electric thermal overload relay 1	Function	1 / 2	1	17
F11		Level	0.0 (Disable) 1 ~ 135% I_N Mot.	Nominal rated current (100%) of the motor	17
F12		Time	0.5 ~ 75min	5.0 (22kW or below) / 10.0 (30kW or below)	17
F14	Restart after moment. power failure		0 ~ 5	1	18
F15	Frequency limiter	high	0~120Hz	70.0Hz	
F16		low	0~120Hz	0.0Hz	19
F18	Bias Frequency 1		-100.00~+100.00 %	0.00%	
F20	DC Brake	Frequency	0.0~60.0Hz	0.0Hz	
F21		Level	0 ~ 100%	0%	
F22		Time	0 / 0.01 ~ 30.0s	0.00s	
F23	Starting frequency		0.1 ~ 60.0Hz	0.5Hz	
F25	Stopping frequency		0.1 ~ 60.0Hz	0.2Hz	
F26	Motor Sound	Carrier frequency	0.75~15 kHz (22kW or below)	15kHz	19
			0.75~10 kHz (30kW to 75kW)	10kHz	19
			0.75~6 kHz (90kW or above)	6kHz	19

F27		Tone	0~3	0	
F29	Analog Output (FMA)	Selection	0 / 1	0	
F30		Level	0~200%	100%	
F31		Function	0 ~ 16	0	
F33	FMP Terminal	Pulsrate	25 ~ 6000p/s	1440p/s	
F34		Level	0% / 1 ~ 200%	0%	
F35		Function	0 ~ 16	0	
F37	Load selection / Auto torque boost/ Auto energy saving operation		0 ~ 5	1	17
F43	Current limiter	Selection	0 ~ 2	0	
F44		Level	20 ~ 120% I_N Mot.	110%	

	The shaded function codes are applicable to the quick setup

E codes : Extension Terminal functions

Code	Name		Setting Range	Factory default	
E01	X1 Terminal Function		0 ~ 89	6	
E02	X2 Terminal Function			7	
E03	X3 Terminal Function			8	
E04	X4 Terminal Function			11	
E05	X5 Terminal Function			35	
E20	Y1 Terminal Function		0 ~ 99	0	
E21	Y2 Terminal Function			1	
E22	Y3 Terminal Function			2	
E24	Y5A / Y5B Terminal Function			15	
E27	30A/B/C Terminal Function			99	
E31	Frequency detection FDT	Level	0~120Hz	60Hz	
E34	Overload Early Warning Current detection	Level	0 / 1~150% of the inverter current	Nominal rated current (100%) of the motor	
E35		Timer	0. 1~600.0s	10.0s	
E40	Display coefficient A		-999.00 ~ 999.00	100	
E41	Display coefficient B		-999.00 ~ 999.00	0.0	
E43	LED Monitor	Function	0 ~ 17	0	
E45	LCD Monitor*3	Selection	0 / 1	0	
E46		Language	0 ~ 5	1	
E47		Contrast	0 ~ 10	5	
E48	LED Monitor	Speed item	0 ~ 7	0	
E50	Coefficient for speed indication		0.01 ~ 200.00	30	
E51	Display Coefficient for Input W/h data		0.000 (Cancel/reset) 0.001 ~ 9999	0.010	
E52	Keypad (Menu display mode)		0 ~2	0	19
E61	Analog input signal selection	Terminal 12	0 ~ 3 / 5 / 20	0	
E62		Terminal C1		0	
E63		Terminal V2		0	
E64	Saving of the digital set frequency		0 / 1	0	
E65	Command loss detection	Level	0 / 1 ~ 120 / 999	999	
E80	Detect low torque	Level	0 ~ 150%	20%	
E81		Timer	0.01 ~ 600.00s	20s	
E98	Terminal command	FWD	0 ~ 89	98	
E99		REV		99	

	The shaded function codes are applicable to the quick setup

C codes: Control functions of frequency

Code	Name		Setting Range	Factory default	
C01	Jump frequency	1	0.0 ~ 120Hz	0.0Hz	
C02		2		0.0Hz	
C03		3		0.0Hz	
C04		Hysterics	0.0 ~ 30Hz	0.0Hz	
C05	Multistep frequency setting	Frequency 1	0.00 ~ 120.00Hz	0.00Hz	
C06		Frequency 2		0.00Hz	
C07		Frequency 3		0.00Hz	

C08		Frequency 4		0.00Hz	
C09		Frequency 5		0.00Hz	
C10		Frequency 6		0.00Hz	
C11		Frequency 7		0.00Hz	
C30	Frequency command 2		0 ~ 3 / 5 / 7	2	14
C32	Analog input gain adjustment	Terminal 12	0.00 ~ 200.00 %	100.00%	
C33		Signal filter	0.00 ~ 5.00s	0.05s	
C34		Gain base point	0.00 ~ 100.00%	100%	
C37	Analog input gain adjustment	Terminal 1	0.00 ~ 200.00 %	0.00Hz	
C38		Signal filter	0.00 ~ 5.00s	0.00Hz	
C39		Gain base point	0.00 ~ 100.00%	0.00Hz	
C42	Analog input gain adjustment	Terminal V2	0.00 ~ 200.00 %	0.00Hz	
C43		Signal filter	0.00 ~ 5.00s	0.00Hz	
C44		Gain base point	0.00 ~ 100.00%	0.00Hz	
C50	Bias Frequency command 1	Bias base point	0.00 ~ 100.0%	0.00%	
C51	Bias PID command 1	Base value	-100 ~ 100%	0.00%	
C52		Bias base point	0.00 ~ 100.00%	0.00%	
C53	Selection of normal / inverse operation for the frequency command 1		0 / 1	0	

P codes: Motor parameters

Code	Name		Setting Range	Factory default	
P01	Motor	Number of poles	2 ~ 22	4	
P02		Rated capacity	0.01 ~ 1000 kW	Nominal rated capacity of the standard motor	20
P03		Rated current	0.00 ~ 2000A	Nominal rated current of the standard motor	20
P04		Auto tuning	0 / 1 / 2	0	20
P06		No-load current	0.00 ~ 2000A	Nominal rated value of the standard motor	
P07		%R1 Setting	0.00 ~ 50.00%		
P08		%X Setting	0.00 ~ 50.00%		
P99		Selection	0 ~ 4	0	20

	The shaded function codes are applicable to the quick setup

*1 When you make settings from the keypad, the incremental unit is restricted by the number of digits that the LED monitor can display.
(Example) If the setting range is from -200.00 to 200.00, the incremental unit is:
"1" for -200 to -100, "0.1" for -99.9 to -10.0 and for 100.0 to 200.0, and "0.01" for -9.99 to -0.01 and for 0.00 to 99.99.

*2 The H86 through H91 are displayed, but they are reserved for particular manufacturers. Unless otherwise specified, do not access these function codes.

*3 The H80 select 0.10 for models of 55 kW or above (400 V series), 0.20 for models 45 kW or below (400 V series).

*4 The H86 select 2 for models of 55 kW or above (400 V series), 0 for models 45 kW or below (400 V series).

6.2 Overview of Function Codes

This section provides an overview of the function codes frequently used for the FRENIC-Eco series of inverter.

📖 For details of the function codes given below and other function codes not given below, refer to the FRENIC-Eco User's Manual (MEH456), Chapter 9 "FUNCTION CODES."

F01	Frequency Command 1
C30	Frequency Command 2

Selects the devices to set the frequency command 1 for driving the motor.

F01	To do this
0	Enable ⌃ and ⌄ keys on the built-in keypad. (Refer to Chapter 4 "OPERATION USING THE KEYPAD.")
1	Enable the voltage input to terminal [12] (0 to 10 VDC).
2	Enable the current input to terminal [C1] (4 to 20 mA DC).
3	Enable the sum of voltage and current inputs to terminals [12] and [C1]. See the two items listed above for the setting range and maximum frequencies. Note: If the sum exceeds the maximum frequency, the maximum frequency will apply.
5	Enable the voltage input to terminal [V2] (0 to 10 VDC).
7	Enable (UP) and (DOWN) commands assigned to the digital input terminals (UP) command (data=17) and (DOWN) command (data=18) to the input terminals [X1] to [X5].

Note Certain setting means (e.g., communication link and multistep frequency) have priority over these settings. For details, refer to the block diagram in the FRENIC-Eco User's Manual (MEH456), Chapter 4, Section 4.2 "Drive Frequency Command Generator."

F02 Operation Method

Select the source issuing a run command for running the motor.

F02	Running Mode	Source of Run Command
0	Running per keypad (rotation direction: determined by terminal block)	Enables the RUN key and the STOP key on the keypad to start and stop the motor. In the case of a standard keypad, the direction of rotation is determined by the commands given at terminals FWD and REV. In the case of a multi-functional keypad, there is no need to specify the direction of rotation.
1	External signal	Enables the external signals given at terminals FWD and REV to run the motor.
2	Running per keypad (forward rotation)	Enables the RUN key and the STOP key on the keypad to start and stop the motor. There is no need to specify the direction of rotation, since only forward rotation is allowed. In the case of a multi-functional keypad, only the FWD key is effective.
3	Running per keypad (reverse rotation)	Enables the RUN key and the STOP key on the keypad to start and stop the motor. There is no need to specify the direction of rotation, since only reverse rotation is allowed. In the case of a multi-functional keypad, only the REV key is effective.

Tip When function code F02 = 0 or 1, the forward running/stopping function (FWD) and the reverse running /stopping function (REV) must be assigned to terminals FWD and REV, respectively.

In addition to the function code F02 described above, there are several other means available with priority over F02. For details, refer to the block diagram in FRENIC-Eco User's Manual (MEH456), Chapter 4, Section 4.3 "Drive Command Generator."

Note
- Digital input commands (FWD) and (REV) are valid for specifying the motor rotation direction, and the commands (FWD2) and (REV2) are invalid.
- If you have assigned the (FWD) or (REV) function to the [FWD] or [REV] terminal, you cannot change the setting of function code F02 while the terminals [FWD] and [PLC]* or the terminals [REV] and [CM]* are short-circuited.
- If you have specified the external signal (F02 = 1) as the running command and have assigned functions other than the (FWD) or (REV) function to the [FWD] or [REV] terminal, caution should be exercised in changing the settings. Because, if under this condition you assign the (FWD) or (REV) function to the [FWD] or [REV] terminal while the terminals [FWD] and [PLC]* or the terminals [REV] and [PLC]* are short-circuited, the motor would start running.

  *[PLC] replaces with [CM] for SINK mode.

When "Local" is selected by Remote/Local switching, the operation of the keypad concerning run commands varies with the setting of F02. For details, refer to Chapter 4.

F03	Maximum Frequency

Sets the maximum frequency to drive the motor.
Setting the frequency out of the range rated for the equipment driven by the inverter may cause damage or a dangerous situation. Set a maximum frequency appropriate for the equipment.

⚠CAUTION

The inverter can easily set high-speed operation. When changing the speed setting, carefully check the specifications of motors or equipment beforehand.
Otherwise injuries could occur.

Tip If you modify the data of F03 to apply a higher drive frequency, concurrently change the data of F15 for a high frequency limiter suitable to the drive frequency.

F04	Base Frequency
F05	Rated Voltage (at base frequency)

These function codes set the base frequency and the voltage at the base frequency essentially required for running the motor properly.

■ Base Frequency (F04)

Set the rated frequency printed on the nameplate located on the motor.

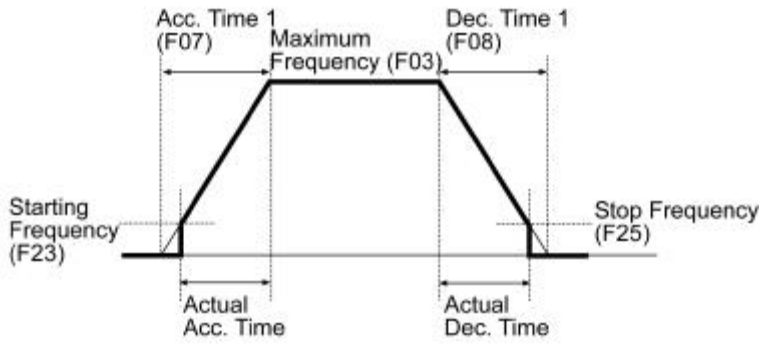
■ Rated Voltage (at base frequency) (F05)

Set 0 or the rated voltage printed on the nameplate labeled on the motor.

- If 0 is set, the inverter supplies voltage equivalent to that of the power source of the inverter at the base frequency. In this case, the output voltage will vary in line with any variance in input voltage.
- If the data is set to anything other than 0, the inverter automatically keeps the output voltage constant in line with the setting. When any of the automatic torque boost settings, automatic energy saving is active, the voltage settings should be equal to the rating of the motor.

F07	Acceleration Time 1
F08	Deceleration Time 1

The acceleration time specifies the length of time the frequency increases from 0 Hz to the maximum frequency. The deceleration time specifies the length of time the frequency decreases from the maximum frequency down to 0 Hz.



F09	Torque Boost
F37	Load Selection/Auto Torque Boost/Auto Energy Saving Operation

■ Torque Boost

• Manual torque boost per F09

In torque boost using F09, you are adding a certain amount of voltage, regardless of the load, to the output voltage that is determined by the basic V/f characteristics. To secure a sufficient starting torque, manually adjust the output voltage to optimally match the motor and its load by using F09. Select an appropriate level that guarantees smooth start-up and yet does not cause over-excitation with no or light load.

Torque boost per F09 ensures high driving stability since the output voltage remains constant regardless of the size of the load.

Specify the value for function code F09 in ratio (percentage) to the base frequency. At factory shipment, it is preset to a level that ensures a certain amount (50%) of starting torque.

Note Specifying a high torque boost level will generate a high torque, but may cause overcurrent due to over-excitation when there is no or very light load. If you continue to drive the motor, it may overheat. To avoid such a situation, adjust torque boost to an appropriate level.

These function codes optimize the operation in accordance with the characteristics of the load. Function code F37 specifies V/f pattern, torque boost, and automatic energy saving functions. F09 specifies the amount of torque boost in order to provide sufficient starting torque.

Data for F37	V/f characteristics	Torque boost	Auto-energy saving function	Applicable load
0	Non-linear torque load	Preset torque boost manually set by F09	Disabled	Fans and pumps with general properties
1	Constant torque load			Pumps require high starting torque*1
2		Auto-torque boost		Pumps require high starting torque (With a motor over excited at no load)
3	Non-linear torque load	Preset torque boost manually set by F09	Enabled	Fans and pumps with general properties
4	Constant torque load			Pumps require high starting torque*1
5		Auto-torque boost		Pumps require high starting torque (With a motor over excited at no load)

*1 If a (load torque + acceleration toque) needs 50% or more parts of the constant torque, you have to apply the linear V/f pattern set by factory defaults.

F10 to F12	Electronic Thermal Overload for Motor Protection (Select the motor property, overload detection level, and thermal time constant)

F10 through F12 set the thermal characteristics of the motor for electronic thermal simulation, which is used to detect overload conditions of the motor. More specifically, F10 specifies the motor characteristics, F11 the overload detection level, and F12 the thermal time constant.

Note Thermal characteristics of the motor specified by these function codes are also used for the overload early warning. Therefore, even if you need only the overload early warning, set these characteristics data to function codes F10 and F12. To disable electronic thermal simulation, set function code F11 to "0.00."

■ Motor Characteristics (F10)

F10 selects the cooling characteristics of the motor--built-in cooling fan or externally powered forced-ventilation fan.

F10	If the motor is cooled by:
1	Built-in cooling fan for general-purpose motors (self-cooled) (The cooling performance will decrease with low frequency operations.)
2	Forced-ventilation fan powered by an external source for an motor (The cooling performance will be kept constant regardless of the output frequency.)

■ Operation Level (F11)

F11 specifies the level at which an overload condition is to be recognized. Ordinarily, set F11 to 1.0 to 1.1 times the allowable continuous current (rated current of the motor (P03)) at the rated drive frequency (base frequency) of the motor. To disable the electronic thermal function, set F11 to 0.00 (no effect).

■ Thermal Time Constant (F12)

F12 sets the thermal time constant of the motor. The inverter interprets the time constant as an operation period of the electronic thermal function. During the specified operation period, the inverter will activate the electronic thermal function if 150% current of the operation level specified by F11 flows continuously.

The thermal constants of most general-purpose motors are set at about 5 minutes for capacities of 22 kW or below or about 10 minutes for capacities of 30 kW or above at the time of factory shipment.

Data entry range: 0.5 to 75.0 (minutes, in 0.1-minute increment)

F14 Restart Mode after Momentary Power Failure (Mode selection)

These function codes specify the mode and action to be taken in the event of a momentary power failure (such as tripping and restart).

■ Restart after Momentary Power Failure (mode selection) (F14)

F14	Mode	Description
1	No restart after momentary power failure (Trip immediately)	As soon as the voltage of the DC link circuit drops below the lower limit after a momentary power failure, the output of the inverter is shut down, with an undervoltage alarm "*LU*" displayed, and the motor enters a coast-to-stop state.
2	No restart after momentary power failure (Trip after recovery of power)	As soon as the voltage of the DC link circuit drops below the lower limit after a momentary power failure, the output of the inverter is shut down, without an undervoltage alarm "*LU*" displayed, and the motor enters a coast-to-stop state. When power is restored, an undervoltage alarm "*LU*" is displayed, while the motor remains in coast-to-stop state.
3	Restart after momentary power failure (Continuous running)	When the voltage of the DC link circuit drops below the lower limit after a momentary power failure, continuous running control is invoked. Continuous running control regenerates kinetic energy due to the load's moment of inertia by slowing down the motor and prolongs the running time. When an undervoltage condition is detected due to a lack of energy to be regenerated, the output frequency at that time is saved, the output of the inverter is shut down, and the motor enters a coast-to-stop state. When power is restored, if a run command has been received restart takes place at the frequency saved at the time of the power failure. This setting is ideal for applications with a large moment of inertia such as a fan.
4	Restart after momentary power failure (Restart at the frequency at which	As soon as the voltage of the DC link circuit drops below the lower limit after a momentary power failure, the output frequency at the time is saved, the output of the inverter is shut down, and the motor enters a coast-to-stop state. When power is restored, if a run command has been received restart begins at the frequency saved at the time of the power failure. This setting is ideal for

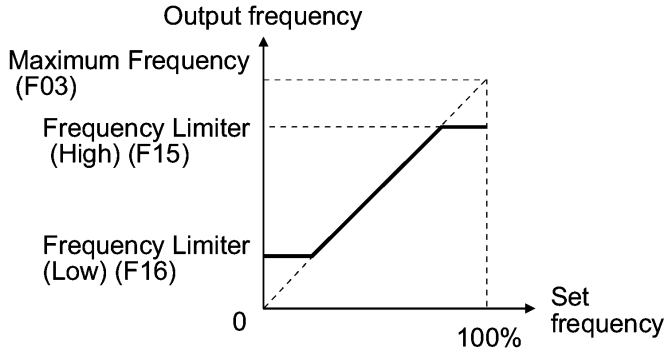
	the power failure occurred)	applications with a moment of inertia large enough not to slow down the motor quickly (such as a fan) after it enters a coast-to-run state as a result of a momentary power failure.
5	Restart after momentary power failure (restart at starting frequency)	After a momentary power failure, when power is restored and a run command is received, restart begins at the start frequency command by function code F23. This setting is ideal for applications with a heavy load having a small moment of inertia, in which the motor speed quickly goes down to zero as soon as it enters a coast-to-stop state as a result of a momentary power failure (such as a pump).

⚠WARNING

If you select restart after momentary power failure (F14 = 3, 4 or 5), the inverter will automatically restart running the motor when power is recovered.
The machine should be so designed that human body and peripheral equipment safety is ensured even after automatic restarting.
Otherwise an accident could occur.

F16 Frequency Limiter (Low)

Frequency limiter (low) F16 sets the lower limit of the output, as shown below.



F26 Motor Sound (Carrier frequency)

■ Motor Sound (Carrier frequency) (F26)

This function controls the carrier frequency so as to reduce a sound noise issued by the motor or inverter itself, and to decrease a leakage current from the main output wirings.

E52 Keypad (Menu display mode)

Selects the menu display mode on the built-in keypad as shown in the table below.

Menu #	LED monitor shows:	Function	What is displayed:
0	*0.fnc*	Quick Setup	Quick setup function code
1	1.F__	Data Setting F to o codes	One of F through o function code
2	2.rEP	Data Checking	New function code data (for confirmation after modification)
3	3.oPE	Drive Monitoring	Running status

4	4.I_O	I/O Checking	Status of DIO, and AIO
5	5.CHE	Maintenance Information Display	Maintenance information
6	6.AL	Alarm Information Display	Alarm information
7	7.CPY	Data Copying	Copied function code

For details of each menu item, refer to Chapter 4, "OPERATION USING THE KEYPAD."

P02 Motor (Rated capacity)

P02 specifies the rated capacity of the motor. Enter the rated value shown on the nameplate of the motor.

Data for P02	Unit	Dependency on function code P99
0.01 to 1000	kW	P99 = 0, 3 or 4
	HP	P99 = 1

P03 Motor (Rated current)

P03 specifies the rated current of the motor. Enter the rated value shown on the nameplate.

P04 Motor (Auto-tuning)

This function automatically detects the motor parameters and saves them in the inverter's internal memory. Basically, you do not need to perform tuning if you connect the inverter to a standard motor in standard applications.

In any of the following cases, the default settings may not produce the best results for auto torque boost, torque calculation monitoring, or auto energy saving, since the standard settings of motor parameters for motors are not applicable. In such a case, perform auto-tuning using this feature.

- The motor to be driven is a non-standard product.
- The cabling between the motor and the inverter is long.
- A reactor is inserted between the motor and the inverter.

.Tuning procedure.

1) Preparation

Referring to the rating plate on the motor, set the following function codes to their nominal ratings:

- F04: Base frequency
- F05: Rated voltage (at Base frequency)
- P02: Rated capacity
- P03: Rated current

2) Selection of Tuning Process

Check the situation of the machine system and choose between "Tuning while the motor is stopped (P04 = 1)" or "Tuning while the motor is running (P04 = 2)."

In the case of "Tuning while the motor is stopped (P04 = 1)", 'static tuning' measures the primary resistance (%R1) of the motor and leakage reactance (%X) of the base frequency when the motor is stopping and writes both values in P07 and P08 automatically.

In the case of "Tuning while the motor is running (P04 = 2)", 'dynamic tuning' measures the primary resistance (%R1) of the motor and leakage reactance (%X) of the base frequency when the motor is stopping. It measures also the no-load current (I_0) when the motor is running approximately 50% of the base frequency and writes these values in P06, P07 and P08 automatically.

The 'dynamic tuning' (P04 = 2) can be carried only with a freewheel running motor without load and gear. Please adjust the acceleration and deceleration times (F07 and F08) as well and set the rotation direction properly so that it matches the actual rotation direction of the machine system.

3) Preparation of Machine System

Perform appropriate preparations on the motor and its load, such as disengaging the coupling and deactivating the safety device.

4) Perform tuning

① Set function code P04 to "1" or "2" and press the key. (The blinking of *1* or *2* on the LED monitor will slow down.)

② Enter a Run command for the rotation direction you have chosen. The factory default setting is "forward rotation upon pressing the key on the keypad." To switch to reverse rotation, change the setting of function code F02.

③ The display of *1* or *2* stays lit, and tuning takes place while the motor is stopped.

(Maximum tuning time: approximately 40 sec.)

④ If the function code P04 = 2, the motor is accelerated to approximately 50% of the base frequency and then tuning takes place. Upon completion of measurements, the motor will coast-to-stop.

(Estimated tuning time: Acceleration time + 10 sec + Deceleration time)

⑤ If the terminal signal (FWD) or (REV) is selected as the Run command (F02 = 1), *end* will appear upon completion of the measurements.

⑥ The Run command is turned OFF and the tuning completes, with the next function code *p06* displayed on the keypad (the Run command given through the keypad or the communication link is automatically turned OFF).

■ Errors during Tuning

Improper tuning would negatively affect the operation performance and, in the worst case, could even cause hunting or deteriorate precision. Therefore, if the inverter finds any abnormality in the results of the tuning or any error in the process of the tuning, it will display *er7* and discard the tuning data.

Listed below are the abnormal or error conditions that can be recognized during tuning.

Abnormal / error condition	Description
Abnormal result of tuning	An inter-phase imbalance has been detected; Tuning has resulted in an abnormally high or low value of a parameter.
Abnormal output current	An abnormally high current has been caused during tuning.
Sequence error	During tuning, the Run command has been turned OFF, or forced STOP, coast-to-stop command (BX), dew condensation protection (DWP), or a similar abnormal command has been received.
Limitation exceeded	During tuning, a certain limitation has been reached or exceeded; The maximum output frequency or the peak limiter for output frequency has been reached or exceeded.
Other alarm condition	An undervoltage or an alarm has been occurred.

If any of these conditions has occurred, either eliminate the abnormal or error factor(s) and perform tuning again, or contact your Fuji Electric representative.

Note If a filter other than Fuji optional output filter (OFL-□□□-4A) is connected to the inverter's output (secondary) circuit, the result of tuning can be unpredictable. When you replace an inverter, take note of the old inverter's settings for the primary resistance %R1, the leakage reactance %X, and the no-load current, and set those values to the new inverter's function codes.

P99 Motor Selection

Automatic control such as auto-torque boost, auto-energy saving or electronics thermal simulation (Overheat protection of a motor) uses the motor parameters and characteristics. To match the property of a control system with that of the motor, select characteristics of the motor, and clear the old motor parameter setting H03 to "3." Then, data of P03, P06, P07, and P08 and the old related internal data will be automatically updated. According to the motor model follow the description below to enter the data necessary for motor setup.

- Standard motors (Current standard): P99 = 0 or 4

7. PROTECTIVE FUNCTIONS

7.1 Protection / Maintenance Function (Parameter H98)

Possibility to enable or disable of:

- Automatic lowering of the carrier frequency
- Protection against input phase loss
- Protection against output phase loss
- Judgment and criteria on the life of the main circuit capacitor
- Protection against DC fan lock

Automatic DEC function for carrier frequency

Allows you to enable a mechanism for avoiding an overheat trip or overload trip. If enabled, this mechanism lowers the carrier frequency of the inverter before tripping (with an alarm of *0h1, 0h3* or *0lu*) when an overheating of the heat sink or an overload condition occurs in the inverter as a result of overload, an abnormal ambient temperature, or a problem in the cooling system. This feature is useful for a critical machine installation where it is extremely important to keep the motor running all the time. Note that if this feature is enabled the motor noise increases.

Protection against input phase loss (*lin*)

Upon detecting an excess stress inflicted on the apparatus connected to the main circuit because of a phase loss or an inter-phase imbalance in the 3-phase power supplied to the inverter, this feature stops the inverter and displays an alarm (*lin*).

Note In configurations where only a light load is driven or a DC reactor is connected, a phase loss or an inter-phase imbalance may not be detected because of the relatively small stress on the apparatus connected to the main circuit.

Protection against output phase loss (*0pl*: Output Phase Loss)

Upon detecting a phase loss in the output while the inverter is running, this feature stops the inverter and displays an alarm (*0pl*). In configurations where a magnetic contactor is installed in the power output circuit, if the magnetic contactor goes OFF during operation, all the phases will be lost. In such a case, this protection feature does not work.

Selection of criteria for judging the life of the main circuit capacitor

Allows you to select the criteria for judging the life of the main circuit capacitor between factory default and your own choice.

Note Before specifying the criteria of your own choice, measure and confirm the reference level. For details, refer to the chapter 7 “MAINTENANCE AND INSPECTION” of the FRENIC ECO Instruction manual.

Judgment on the life of the main circuit capacitor

Whether the main circuit capacitor has reached its life is determined by measuring the length of time for discharging after power off. The discharging time is determined by the capacitance of the main circuit capacitor and the load inside the inverter. Therefore, if the load inside the inverter fluctuates significantly, the discharging time cannot be accurately measured, and as a result, it may be mistakenly determined that the life has been reached. To avoid such an error, you can disable the judgment on the life of the main circuit capacitor.

Load may vary significantly in the following cases:

- Auxiliary input for control power is used
- A communication link is used
- Another inverter or another apparatus such as a PWM converter is connected in the DC link circuit.

In these cases, disable the judgment on the life during operation, and either conduct the measurement with the judgment enabled under appropriate conditions during maintenance or conduct the measurement under the actual use conditions. For details, refer to Chapter 7 “MAINTENANCE AND INSPECTION” of the FRENIC ECO Instruction manual.

Detection of DC fan lock (200 V series: 45 kW or above, 400 V series: 55 kW or above)

An inverter of 45 kW or above (200 V series), or of 55 kW or above (400 V series) is equipped with the internal air circulation DC fan. When the inverter detects that the DC fan is locked by a failure or other cause, you can select either continuing the inverter operation or not.

Entering Alarm mode: The inverter issues the alarm 0h1 and coasts to stop the motor.

Continuing operation: The inverter does not enter the alarm mode, and continues operation of the motor.

Note that, however, the inverter turns on (OH) and (LIFE) signals on the transistor output terminals whenever the DC fan lock is detected regardless your selection.

Note If control of the cooling fan is enabled (H06 = 1) the fan will stop depending on operating condition of the inverter. In this case, the DC fan lock detection feature determines this failure for a normal operation state (e.g.; the fan is normally stopped by the stop fan command.) so that the inverter may turn off the (LIFE) or (OH) signal output, or enable to cancel the 0h1 alarm. (When you have started the inverter in this state, it automatically issues the run fan command, then the inverter will detect the DC fan lock state, and turn on the (LIFE) or (OH) output or will enter the *0h1* alarm state.)

Note that, operating the inverter under the condition that the DC fan is locked for long time may cause to shorten the life of electrolytic capacitors on the power printed circuit board due to local high temperature inside the inverter. In this case, replace the broken fan as soon as possible.

To set data of the function code H98, assign functions to each bit (6 bits) and express it in decimal format that is data of the function code. Table on next page lists functions assigned to each bit and example of its decimal expression.

Bit	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
Function	Detect DC fan lock	Judge life of the main circuit capacitors	Select the reference to judge life of the main circuit capacitors	Detect output phase loss	Detect input phase loss	Auto-lower the carrier frequency
Data = **0**	Enter into the alarm state	Disabled	Use the factory default	Disabled	Disabled	Disabled
Data = **1**	Continue the operation	Enabled	Use the user setting	Enabled	Enabled	Enabled

Example of **decimal** expression:H98 = **19 :**	**0**	**1**	**0**	**0**	**1**	**1**

For details see User Manual Chapter 9 (H98 Protection / Maintenance Function)

7.2 Dew Condensation Protection (Parameter J21)

Enables dew condensation protection, which prevents condensation on the motor while in stopped state by feeding a direct current to the motor at regular intervals and thereby keeping the temperature of the motor above a certain level.

To utilize this feature, you need to assign (DWP) (dew protection) to the general-purpose digital input terminals (function code data=39).

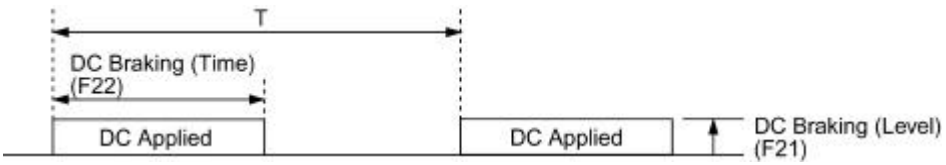
■ Enabling Condition

To enable dew condensation protection, turn ON the condensation protection signal (DWP) while the inverter is in stopped state.

■ Condensation Protection (Duty)

The magnitude of the direct current fed to the motor is the same as the setting of F21 (DC braking: Braking level) and its duration inside each interval is the same as the setting of F22 (DC braking: Braking time). The interval T is determined so that the ratio of the duration of the direct current to T is the value (duty) set for J21.

$$\text{Duty for condensation protection (J21)} = \frac{F22}{T} \times 100\ (\%)$$



Condensation Protection Cycle

8. SPECIFICATIONS AND EXTERNAL DIMENSIONS

8.1 Inverter Specifications

8.1.1 Standard Model – IP20 / IP00

■ 0.75 to 55 kW

Item				Specifications													
Type (FRN_ _ _F1S-4 □)				0.75	1.5	2.2	3.7	5.5	7.5	11	15	18.5	22	30	37	45	55
Nominal applied motor *1)			kW	0.75	1.5	2.2	3.7	5.5	7.5	11	15	18.5	22	30	37	45	55
Output ratings	Rated capacity *2)		kVA	1.9	2.8	4.1	6.8	9.5	12	17	22	28	33	44	54	64	77
	Rated voltage *3)		V	Three-phase, 380, 400 V/50 Hz, 380, 400, 440, 460 V/60 Hz (with AVR function)													
	Rated current *4)		A	2.5	3.7	5.5	9.0	12.5	16.5	23	30	37	44	59	72	85	105
	Overload capability			120% of rated current for 1 min													
	Rated frequency			50, 60 Hz													
Input ratings	Phases, voltage, frequency	Main power supply		Three-phase, 380 to 480V, 50/60 Hz											Three-phase, 380 to 440 V/50 Hz Three-phase, 380 to 480 V/60 Hz		
		Auxiliary control power input		Single-phase, 380 to 480 V, 50/60 Hz											Single-phase, 380 to 440 V/50 Hz Single-phase, 380 to 480 V/60 Hz		
		Auxiliary fan power input *5)		None													*10)
	Voltage/frequency allowance			Voltage: +10 to -15% (Voltage unbalance: 2% or less (*9)), Frequency: +5 to -5%													
	Rated current *6)	(with DCR)	A	1.6	3.0	4.5	7.5	10.6	14.4	21.1	28.8	35.5	42.2	57.0	68.5	83.2	102
		(without DCR)	A	3.1	5.9	8.2	13.0	17.3	23.2	33.0	43.8	52.3	60.6	77.9	94.3	114	140
	Required power supply capacity *7)		kVA	1.2	2.2	3.1	5.3	7.4	10	15	20	25	30	40	48	58	71
Braking	Torque *8)		%	20										10 to 15			
	DC injection braking			Starting frequency: 0.0 to 60.0 Hz, Braking time: 0.0 to 30.0 s, Braking level: 0 to 60%													
DC REACTOR (DCR)				Option													
Applicable safety standards				UL508C, C22.2 No.14, EN50178:1997 (Applying)													
Enclosure (IEC60529)				IP20, UL open type										IP00, UL open type			
Cooling method				Natural cooling		Fan cooling											
Mass			kg	3.1	3.2	3.3	3.4	3.4	5.8	6.0	6.9	9.4	9.9	11.5	23	24	33

*1) Fuji 4-pole standard motor

*2) Rated capacity is calculated by assuming the output rated voltage as 440 V for three-phase 400 V series.

*3) Output voltage cannot exceed the power supply voltage.

*4) An excessively low setting of the carrier frequency may result in the higher motor temperature or tripping of the inverter by its overcurrent limiter setting. Lower the continuous load or maximum load instead. (When setting the carrier frequency (F26) to 1 kHz, reduce the load to 80% of its rating.)

*5) Use (R1, T1) terminals for driving AC fans of an inverter powered by the DC link bus, such as by a high power factor PWM converter. (In normal operation, the terminals are not used.)

*6) Calculated under Fuji-specified conditions.

*7) Obtained when a DC REACTOR is used.

*8) Average braking torque (Varies with the efficiency of the motor.)

*9) Voltage unbalance (%) = $\frac{\text{Max. voltage (V) - Min. voltage (V)}}{\text{Three-phase average voltage (V)}}$ x 67 (IEC61800-3 (5.2.3))

If this value is 2 to 3%, use an AC REACTOR.

*10) Single-phase, 380 to 440 V/50 Hz or Single-phase, 380 to 480 V/60 Hz

Note: A box (□) in the above table replaces J depending on the shipping destination.

■ 75 to 500 kW

Item				Specifications												
Type (FRN_ _ _F1S-4□)				75	90	110	132	160	200	220	280	315	355	400	450	500
Nominal applied motor *1)			kW	75	90	110	132	160	200	220	280	315	355	400	450	500
Output ratings	Rated capacity *2)		kVA	105	128	154	182	221	274	316	396	445	495	584	640	731
	Rated voltage *3)		V	Three-phase, 380, 400 V/50 Hz, 380, 400, 440, 460 V/60 Hz (with AVR function)												
	Rated current *4)		A	139	168	203	240	290	360	415	520	585	650	740	840	960
	Overload capability			120% of rated current for 1 min												
	Rated frequency			50, 60 Hz												
Input ratings	Phases, voltage, frequency	Main power supply		Three-phase, 380 to 440 V, 50 Hz or Three-phase, 380 to 480 V, 60 Hz												
		Auxiliary control power input		Single-phase, 380 to 480 V, 50/60 Hz												
		Auxiliary fan power input *5)		Single-phase, 380 to 440 V/50 Hz Single-phase, 380 to 480 V/60 Hz												
	Voltage/frequency allowance			Voltage: +10 to -15% (Voltage unbalance: 2% or less (*9)), Frequency: +5 to -5%												
	Rated current *6)	(with DCR)	A	138	164	201	238	286	357	390	500	559	628	705	789	881
		(without DCR)		—	—	—	—	—	—	—	—	—	—	—	—	—
	Required power supply capacity *7)		kVA	96	114	140	165	199	248	271	347	388	435	489	547	611
Braking	Torque *8)		%	10 to 15												
	DC injection braking			Starting frequency: 0.0 to 60.0 Hz, Braking time: 0.0 to 30.0 s, Braking level: 0 to 60%												
DC REACTOR (DCR)				Standard												
Applicable safety standards				UL508C, C22.2 No.14, EN50178:1997 (Applying)												
Enclosure (IEC60529)				IP00, UL open type												
Cooling method				Fan cooling												
Mass			kg	34	42	45	63	67	96	98						

*1) Fuji 4-pole standard motor

*2) Rated capacity is calculated by assuming the output rated voltage as 440 V for three-phase 400 V series.

*3) Output voltage cannot exceed the power supply voltage.

*4) An excessively low setting of the carrier frequency may result in the higher motor temperature or tripping of the inverter by its overcurrent limiter setting. Lower the continuous load or maximum load instead. (When setting the carrier frequency (F26) to 1 kHz, reduce the load to 80% of its rating.)

*5) Use (R1, T1) terminals for driving AC fans of an inverter powered by the DC link bus, such as by a high power factor PWM converter. (In normal operation, the terminals are not used.)

*6) Calculated under Fuji-specified conditions.

*7) Obtained when a DC REACTOR is used.

*8) Average braking torque (Varies with the efficiency of the motor.)

*9) Voltage unbalance (%) = $\frac{\text{Max. voltage (V) - Min. voltage (V)}}{\text{Three-phase average voltage (V)}}$ x 67 (IEC61800-3 (5.2.3))

If this value is 2 to 3%, use an AC REACTOR.

Note A box (□) in the above table replaces J depending on the shipping destination.

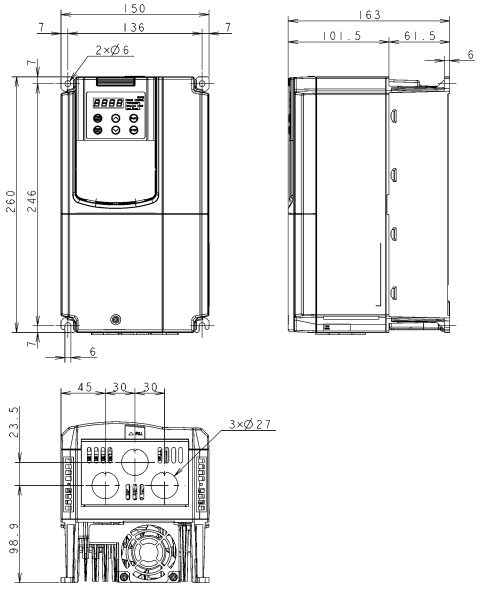
8.1.2 Semi standard – IP54 with integral EMC filter and DCR

Item		Specifications															
Type (FRN???F1L-4E)		0.75	1.5	2.2	3.7	5.5	7.5	11	15	18.5	22	30	37	45	55	75	90
Nominal applied motor [kW] *1)		0.75	1.5	2.2	3.7	5.5	7.5	11	15	18.5	22	30	37	45	55	75	90
Output ratings	Rated capacity [kVA] *2)	1.9	2.8	4.1	6.8	9.5	12	17	22	28	33	44	54	64	77	105	128
	Rated voltage [V] *3)	Three-phase 380V,400V/50Hz, 380V,400V,440V,460V/60Hz (With AVR function)															
	Rated current [A] *4)	2.5	3.7	5.5	9.0	12.5	16.5	23	30	37	44	59	72	85	105	139	168
	Overload capability	120% of rated current for 1min															
	Rated frequency	50, 60Hz															
Input ratings	Main power supply	Three-phase,380 to 480V,50/60Hz											Three-phase, 380 to 440V/50Hz 380 to 480V/60Hz				
	Auxiliary control power input	Single-phase,380 to 480V,50/60Hz											Single-phase, 380 to 440V/50Hz 380 to 480V/60Hz				
	Auxiliary power input for the fans *9)	-													Single-phase, 380 to 440V/50Hz 380 to 480V/60Hz		
	Voltage/frequency variations	Voltage: +10 to -15% (Voltage unbalance: 2% or less *8)), Frequency: +5 to -5%															
	Rated current [A] *5)	1.6	3.0	4.5	7.5	10.6	14.4	21.1	28.8	35.5	42.2	57.0	68.5	83.2	102	138	164
	Required power supply capacity [kVA] *6)	1.2	2.2	3.1	5.3	7.4	10	15	20	25	30	40	48	58	71	96	114
Braking	Torque *7) [%]	20										10 to 15					
	DC injection braking	Starting frequency: 0.0 to 60.0Hz, Braking time: 0.0 to 30.0s, Braking level: 0 to 60%															
EMC filter		Standard conformance: Immunity: 2nd Env. (EN61800-3: 1996+A11:2000) Emission: Class A Group 1 (EN55011: 1998+A1: 1999+A2: 2002)															
DC REACTOR (DCR)		Input power factor : 86% or more at 100% load(Output Rating)															
KEY PAD		Multifunctional Keypad (TP-G1)															
Applicable safety standards		UL508C, C22.2No.14, EN50178:1997(Applying)															
Enclosure		IP54(IEC60529) / UL TYPE 12(UL50)															
Cooling method		Natural cooling	Fan cooling														
Weight / Mass [kg]		12.5	12.5	13	14	14	22	22	24	34	35	40	54	56	74	76	86

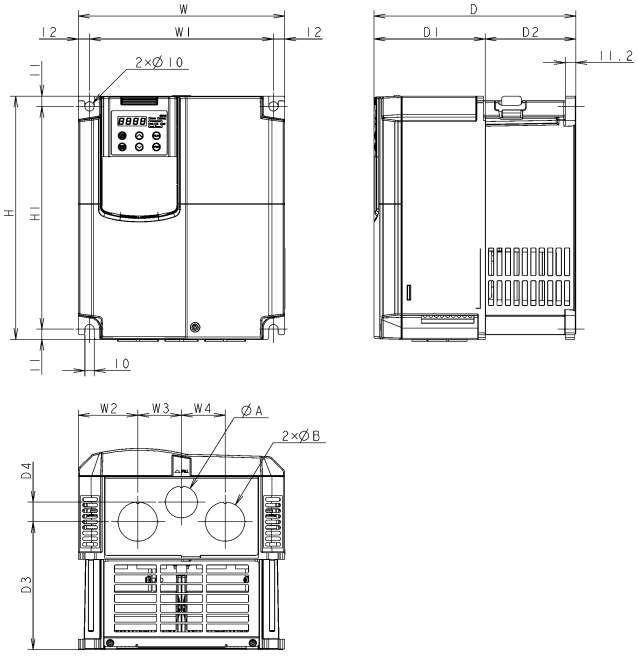
Note
*1) Fuji's 4-pole standard motor
*2) Rated capacity is calculated by regarding the output rated voltage as440V for three-phase 400V series.
*3) Output voltage cannot exceed the power supply voltage.
*4) Motor temperature gets higher or current limit function of the inverter is easy to operate if carrier frequency is set to low. Continuous or peak load shall be reduced to avoid high motor temperature or current limit operation.
When setting the carrier frequency (F26) to 1 kHz or below, reduce the load to 80% of rated load or below for use.
*5) Calculated under Fuji-specified conditions.
*6) Obtained when a DC REACTOR is used.
*7) Average braking torque without optional braking resistor (Varies with the efficiency of the motor.)
*8) $\text{Voltage unbalance} = \dfrac{\text{Max. voltage [V]} - \text{Min. voltage [V]}}{\text{Three - phase average voltage [V]}} \times 67\%$ (IEC61800 – 3(5.2.3))
If this value is 2 to 3%, use an AC REACTOR.
*9) Normally no need to be connected. Use these terminals when the inverter is used with a power regenerative PWM converter (e.g. RHC series).

8.2 External Dimensions

8.2.1 Inverter Standard Models



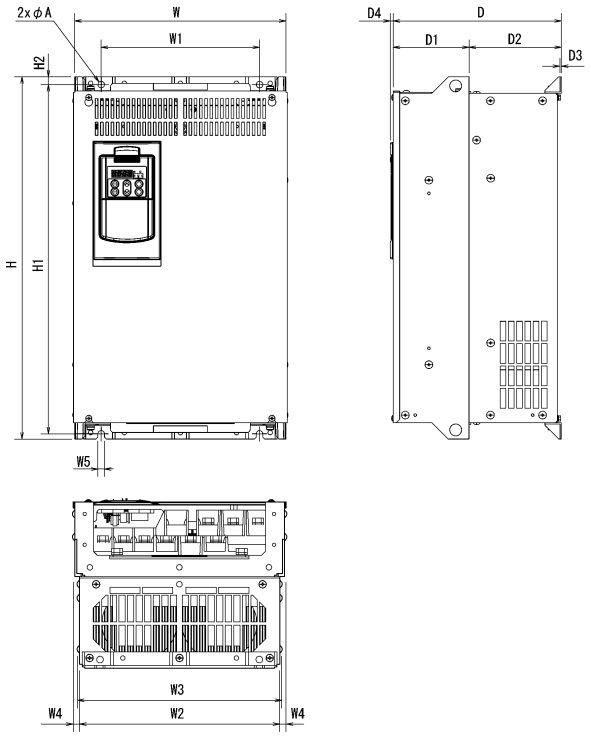
FRN0.75F1S-4 to FRN5.5F1S-4 Unit: mm



FRN7.5F1S-4 to FRN30F1S-4

Power supply voltage	Type	Dimensions (mm)													
		W	W1	W2	W3	W4	H	H1	D	D1	D2	D3	D4	φA	φB
Three-phase 400 V	FRN7.5F1S-4□	220	196	63.5	46.5	46.5	260	238	215	119	96.5	142	16	27	34
	FRN11F1S-4□														
	FRN15F1S-4□											137	21	34	42
	FRN18.5F1S-4□	250	226	67	58	58	400	378		85	130	166	2		
	FRN22F1S-4□														
	FRN30F1S-4□			–	–	–						–	–	–	–

Note: A box (□) is for the area code Unit: mm



FRN37F1S-4 to FRN500F1S-4 Unit: mm

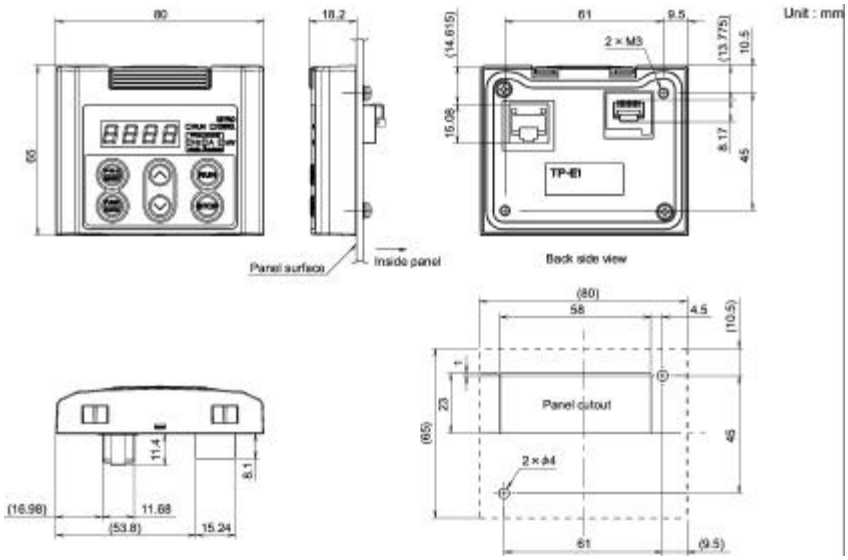
Power supply voltage	Type	Dimensions (mm)														
		W	W1	W2	W3	W4	W5	H	H1	H2	D	D1	D2	D3	D4	φA
Three-phase 400 V	FRN37F1S-4□	320	240	304	310	8	10	550	530	12	255	115	140	4	4.5	10
	FRN45F1S-4□										270		155			
	FRN55F1S-4□	355	275	339	345			615	595							
	FRN75F1S-4□								720		300	145			6	
	FRN90F1S-4□							740								
	FRN110F1S-4□								710		315	135				
	FRN132F1S-4□	530	430	503	509	13.5	15			15.5			180			15
	FRN160F1S-4□										360	180				
	FRN200F1S-4□							1000	970							
	FRN220F1S-4□															

Note: A box (□) is for the area code Unit: mm

8.2.2 Inverter IP54 Models

Will follow soon

8.3 Keypad Dimensions



9. OPTIONS

	Name of option	Function and application
Main option	DC reactors (DCRE)	A DCRE is mainly used for power supply normalization and for supplied power-factor reformation (for reducing harmonic components). Use a DCRE when: - the capacity of a power supply transformer exceeds 500 kVA and is 10 times or more than the rated inverter capacity. In this case, the percentage-reactance of the power source decreases, and harmonic components and their peak levels increase. - there are thyristor-driven loads or when phase-advancing capacitors are being turned ON/OFF. - to increas power factor of the inverter. Using a DCRE improves the input power factor to approximately 86 to 90%. **Note:** DO NOT FORGET TO REMOVE THE BAR on P1 AND P (+) BEVOR INSTALING THE DCRE.
	Output circuit filters (OFLE)	Include an OFLE in the inverter power output (secondary) circuit to: 1) Suppress the voltage fluctuation at the motor input terminals This protects the motor from insulation damage caused by the application of high voltage surge currents by the 400 V class of inverters. 2) Suppress leakage current from the power output lines (due to harmonic components) This reduces the leakage current when the motor is hooked by long power feed lines. It is recommended that the length of the power feed line be kept to less than 400 m. 3) Minimize emission and/or induction noise issued from the power output lines OFLs are effective in reducing noise from long power feed lines, such as those used in plants, etc. **Note:** Use an OFLE within the allowable carrier frequency range specified by function code F26 (Motor sound (carrier frequency)). Otherwise, the filter will overheat.
	Ferrite ring reactors for reducing radio frequency noise (ACL)	An ACL is used to reduce radio noise emitted by the inverter. If wiring length between the inverter and motor is less than 20 m, insert an ACL to the power supply (primary) lines; if it is more than 20 m, insert it to the power output (secondary) lines of the inverter.
	EMC-compliant filter	A special filter for making the inverter with conformity to Europe's EMC directives.
	AC Reactor (ACRE)	This optional feature must be connected to the primary side (commercial power supply side) of the inverter, when the inter-phase unbalance factor of the commercial power supply is 2% to 3%. $\text{Interphase voltage unbalance (\%)} = \frac{\text{Max. voltage (V)} - \text{Min. voltage (V)}}{\text{3 - phase average voltage (V)}} \times 67$ In case the inter-phase unbalance factor of the commercial power supply exceeds 3%, you would need to take other measures such as increasing the capacity of the inverter.
Operation and communication option	Multi-function keypad (TP-G1)	Allows you to monitor the status of the inverter including voltage, current, and input power, as well as to set various parameters in a conversational mode. Equipped with a liquid crystal display (LCD).
	Extension cable for keypad (CB- .. S)	The extension cable connects the RS485 communications port (standard) with a keypad. Three lengths are available: 5 m (CB-5S), 3 m CB-3S) and 1 m (CB-1S)
	RS485 Communications Card (OPC-F1-RS)	This is an internal communication port to a PLC or personal computer system.
	DeviceNet interface card (OPC-F1-DEV)	Use this interface card to communicate to a master station of a DeviceNet.
	Relay output card (OPC-F1-RY)	Use this relay output card to converter transistor outputs issued at terminal Y1 to Y3 of the main body of FRENIC-Eco into relay outputs.
	Inverter support loader software	Inverter support loader software, Windows GUI (Graphics User Interface) based, that makes setting of function codes easy.
	Attachment for external cooling	With this adapter you can mount the FRENIC-Eco on the panel in such a way that the heat sink is outside of the cabinet. Necessary for inverters with a capacity of 30 kW or below.